

REMARKS/ARGUMENTS

This is a full and timely response to the non-final Office Action dated February 14, 2003. Reexamination and reconsideration are courteously requested.

In the Action, claims 1, and 4 to 6 were rejected under 35 U.S.C. § 112, first paragraph due to claims 1 and 4 allegedly containing new matter. The current amendment is believed to overcome the lack of clarity in the claims. Support for the amendment may be found in Figs. 8 and 13 and the supporting text of the specification. It is therefore respectfully requested that the rejections be withdrawn in light of the present amendment.

Claims 1, and 4 to 6 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,146,542 ("Ha") in view of either U.S. Patent No. 5,024,722 ("Cathey") or U.S. Patent No. 5,846,886 ("Hattori"). Further, claims 4 to 6 are rejected as being unpatentable over the above combination of references, further in view of U.S. Patent No. 6,296,780 ("Yan"). These rejections are respectfully traversed.

The present invention is directed to the use of a very particular combination of gases for the purpose of dry etching a metal having specific properties such as those of tungsten, and for making a semiconductor apparatus using the same combination of gases. The background section of the present application teaches that **the combination of gases** is important, as none of the gases alone is sufficient to accomplish the purposes of the inventive methods. There is no doubt that the individual gases used in the etching combination are not new themselves. There is also no doubt that some of these gases are well known to be used in combination for the purpose of etching tungsten. However, as will be established below, the exact combination of gases in the methods of the present invention is new, and there is no teaching or suggestion in the prior art of record for combining the known gases in the manner that the present inventors conceived.

The Ha patent teaches a combination of gases for etching tungsten, with the major exception being that Ha's combination fails to specifically teach that a dry etching mixed gas includes a fluorocarbon. Rather, the Ha patent teaches in its background section that etching of tungsten is performed using fluorine compounds that do not contain carbon, including a mixture of SF₆ and NF₃. The passage of Ha cited by the Examiner simply reads that a fluorine compound

is used to etch tungsten layers, but it would be inferred by a person of skill in the art that the same compounds cited in the background section for this process would be used according to the Ha invention.

This point is further established by the fact that Ha goes on to disclose that a carbon-containing fluorine compound could be used in a subsequent etching step to remove not the tungsten layers, but the diffusion barrier layer (column 4, lines 5 to 8). Therefore a person of ordinary skill in the art would read Ha and ascertain that Ha suggests that a carbon-fluorine type etching gas could be used in diffusion barrier layer etching steps, but that Ha's tungsten etching step is performed using a combination of gases that includes the presently claimed gases, with the replacement of one or more of SF₆ and NF₃ for the claimed carbon-containing fluoride gas.

Consequently, in order for the present invention to be rendered obvious, there must be some teaching somewhere in the prior art that Ha's etching gas combination should replace SF₆ and/or NF₃ with a carbon-containing fluoride gas.

Cathey and Hattori clearly fail to suggest such a replacement. The Examiner asserts in the Office Action that Cathey or Hattori teach that suitable etchants for etching tungsten can be CF₄, NF₃, or SF₆, implying that knowledge of the use of such compounds as tungsten etching agents is sufficient motivation for the replacement of Ha's SF₆ and/or NF₃ with a carbon-containing fluoride gas. However, it is again emphasized that the present invention is not directed to a single etching gas, but a very particular combination of gases. The replacement of one gas for another in a particular combination of gases, like the Ha combination, must be done with some motivation, and the broad assertion that one gas is known tungsten etchant is not sufficient motivation to replace one gas for another gas in a specific combination of gases, especially when there is no teaching or suggestion that the particular combination is in any way deficient or in need of improvement. Neither Cathey nor Hattori teach or suggest that CF₄ performs suitably as an etching procedure when combined with nitrogen. Nitrogen is completely absent from the teachings of Cathey and Hattori. Thus, a person of ordinary skill in the art would recognize that Cathey and Hattori have not considered the use of CF₄ in an etching gas combination that includes all of the gases listed in claims 1 and 4 of the present application. Thus, such a person would not be motivated from reviewing the references as a whole to replace CF₄ from Cathey or Hattori with SF₆ or NF₃. This is particularly true in light of Ha's inherent

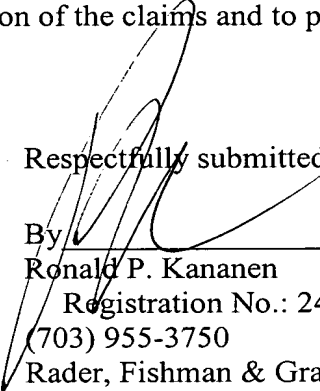
teaching away from making such a replacement, as discussed above.

The Yan reference fails to compensate for the deficiencies of the prior art discussed above. Yan mentions that carbon-containing fluoride gas may be used to process a substrate including an OARC layer and a TiN ARC layer, but makes no mention of using the claimed combination of gases for etching tungsten. Therefore, the combination of Ha, Cathey, Hattori, and Yan does not teach or suggest the method of the present claims.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

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